Impact Evaluation Highlights:
2020-2021 Cold-Climate Heat Pump (CCHP) Pilots with Income Qualified Multifamily & Small Business Customers

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Presented to the Michigan Energy Waste Reduction (EWR) Collaborative
November 21, 2023

Agenda

- High Level Background of Pilot
- Energy Impacts: Main Findings & Lessons Learned
- Income Qualified Multifamily Highlights
- Q&A
- Small Business Pilot Highlights
- Q&A
- Available Appendices with Methodology

Background & Main Impact Findings

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2020-2021 CCHP Customer Initiatives

The MPSC authorized two primary cold-climate heat pump (CCHP) initiatives in the Company's final approved **2020-2023 Energy Waste Reduction Plan** (Case No. U-20372):

1. Dedicated Income Qualified product CCHP investment with installation targets for both single and multifamily units

2. CCHP retrofit pilot for homes and businesses heated with non-MPSC-regulated fuels such as propane

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Customer Groups for CCHP Initiatives

Company created CCHP efforts targeted to **4** customer segments

Today's presentation **begins introduction** to evaluation results & focuses on **energy impact** evaluation results of **2** customer segments.

- Residential customers with electric or distributed fuel heating
- Income-qualified single-family customers with electric or distributed fuel heating
- Income-qualified multifamily customers with electric heating
- Small business customers with propane or wood-fired heating

Portion of an 8-part Comprehensive Evaluation

Residential Single Family

- Participant surveys
- Billing analysis

Income-qualified Multifamily

- Property owner interviews
- Tenant surveys
- Billing analysis

Commercial

- Participant interviews
- Equipment metering

+ Cross-cutting: Contractors, Distributors, and Manufacturers Interviews

- Comprehensive results are included in evaluation reports filed in 2021 and 2022 which include process & impact evaluation results for all segments.
- Let us know if interest in additional presentations on that detail in future EWR Collaboratives.

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Overview: IQ Multifamily Pilot

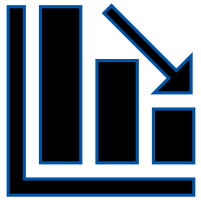
Pilot Background

The pilot was implemented from 2020-2021 and offered **free CCHP unit installations** to Income Qualified Multifamily customers

Impact Evaluation

To **assess impact on energy consumption** of installing CCHP units in multifamily apartments

Analysis Methodology



Estimate energy savings by analyzing pre/post install billing data from **663 CCHP participants relative to non-participants**

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Overview: Small Business CCHP Pilot

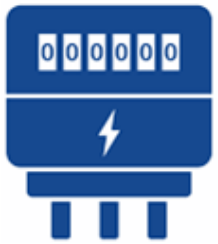
Pilot Background

The pilot was implemented through 2021 and offered **free CCHP unit installations** to small business customers

Impact Evaluation

The **impact** evaluation goal was to **quantify the impacts** of installing CCHP units on customer's energy consumption and GHG emissions

Analysis Methodology



The usage of **22 CCHP units** installed through the pilot were metered to analyze the energy-saving results

Major Findings

Most Income Qualified Multifamily electrically heated pilot homes that installed cold climate heat pumps **saved energy**, **but 20% had a negative outcome** and saw significant increases in bills:

- 80% of customers saved energy and **reduced bills 32% on average**
- 20% of customers saw **consumption and bills increase by 24%**

Small business customers that installed Cold Climate Heat Pumps**:**

- Reduced average cooling electricity usage by **36% (2,875 kWh)** and heating energy usage by **74% (1,001 MMBtu)**
- Reduced average carbon dioxide emissions by **44% (88,870 lb)**

Impact Lessons Learned

Need for additional analysis and efforts to avoid negative outcomes for these customers least able to afford them:

- Additional analysis of appropriate use cases for heat pumps among IQ customers
- Exploring communications/training solutions to reduce usage that increases bills such as use of redundant baseboard heating

Need for additional strategies to:

- Educate contractors on importance of installing in high occupancy areas to maximize usage and savings
- Providing additional training and appropriate use information to customers to maximize savings

Income Qualified Multifamily Pilot: Impact Evaluation Highlights

Evaluation: Noah Lieb, Apex Analytics

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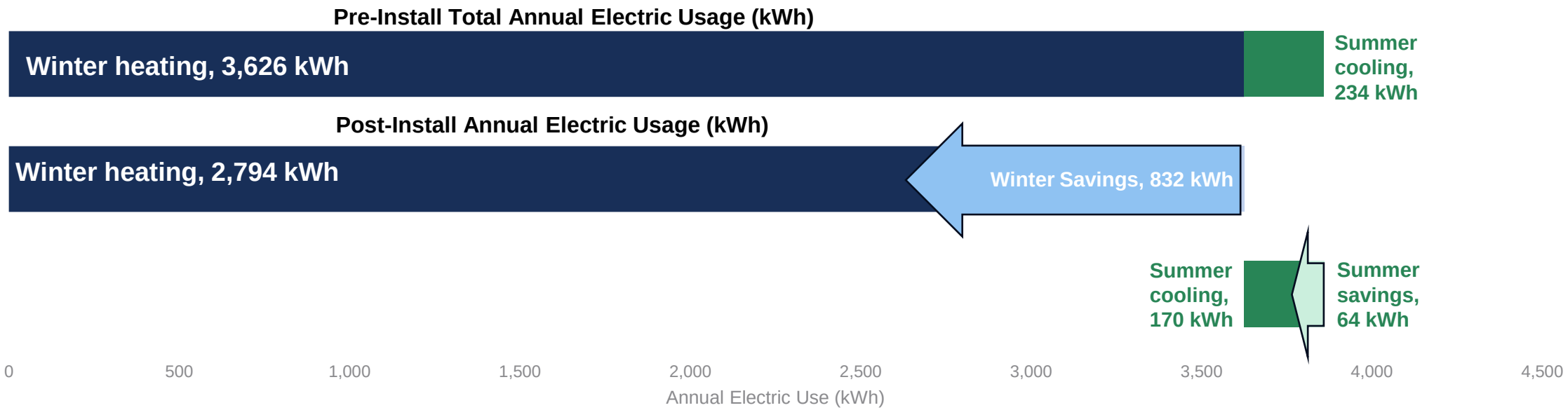
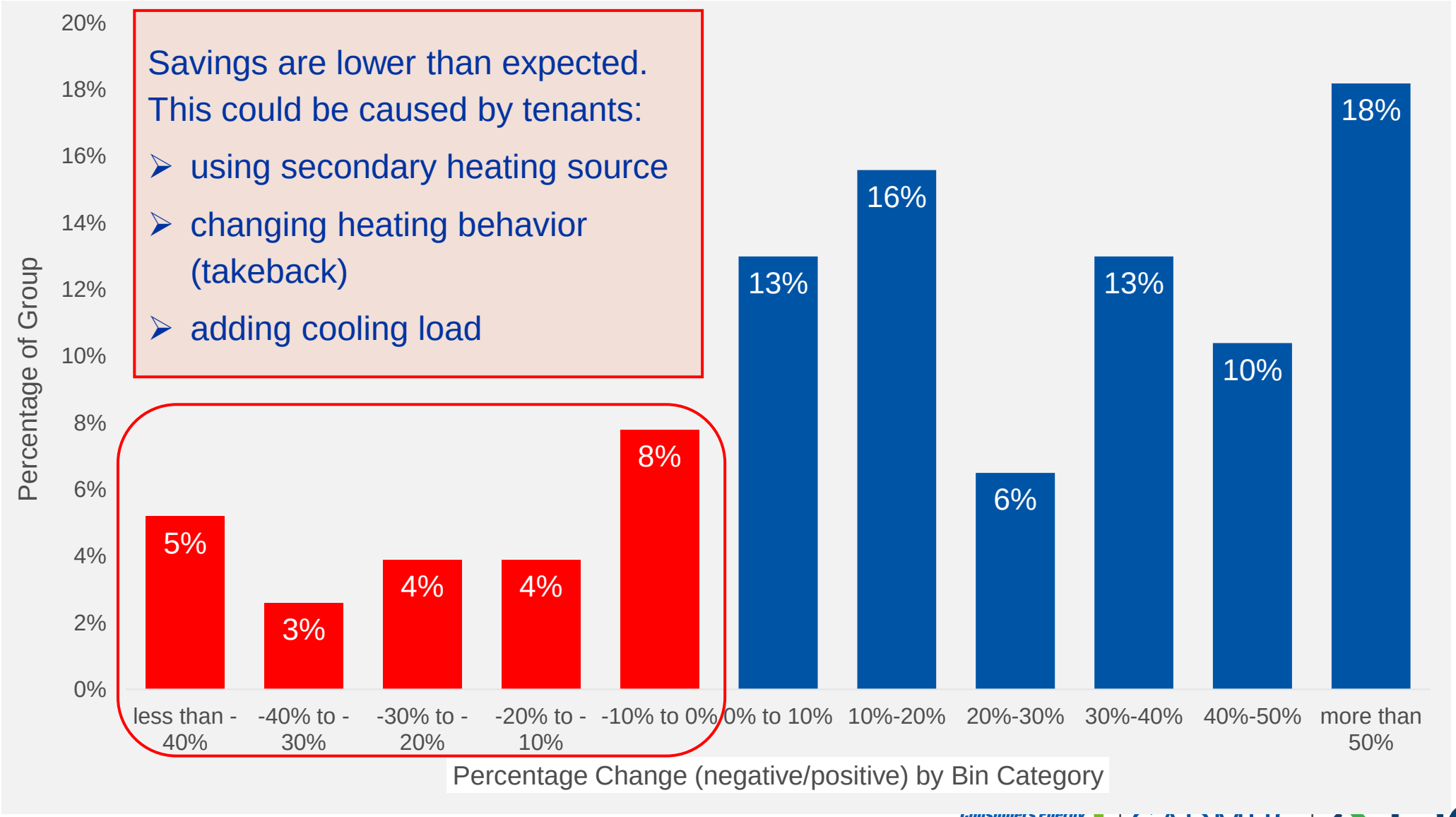
Heat Pumps Saved Energy Across both Seasons

Participants saved **832 kWh (23%)** of their pre-period winter heating electricity usage and **64 kWh (27%)** of their pre-period summer electricity usage

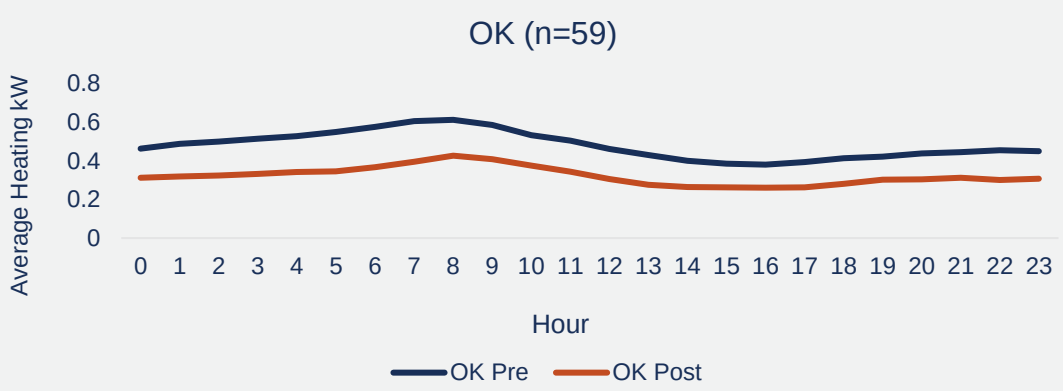


20% of Participants Saw **Increased Use**

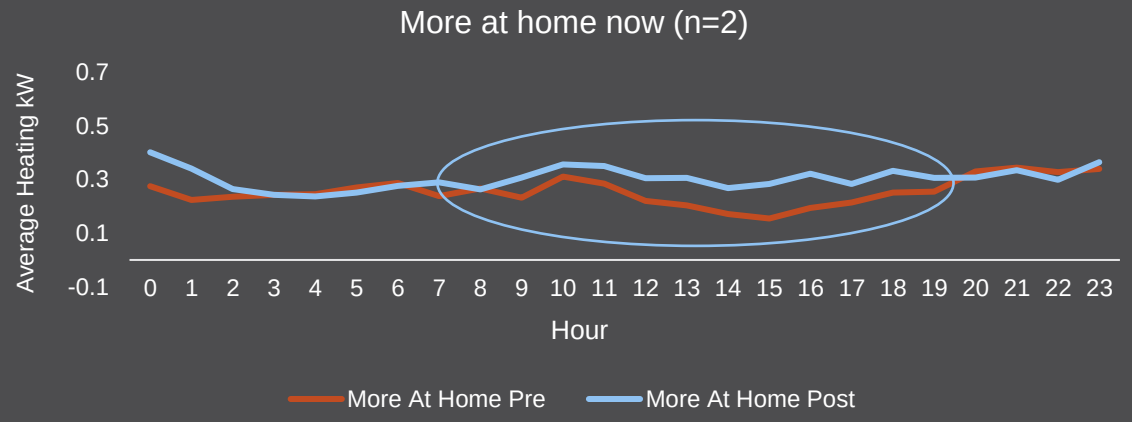


Deeper Analysis of Energy Savings Revealed…

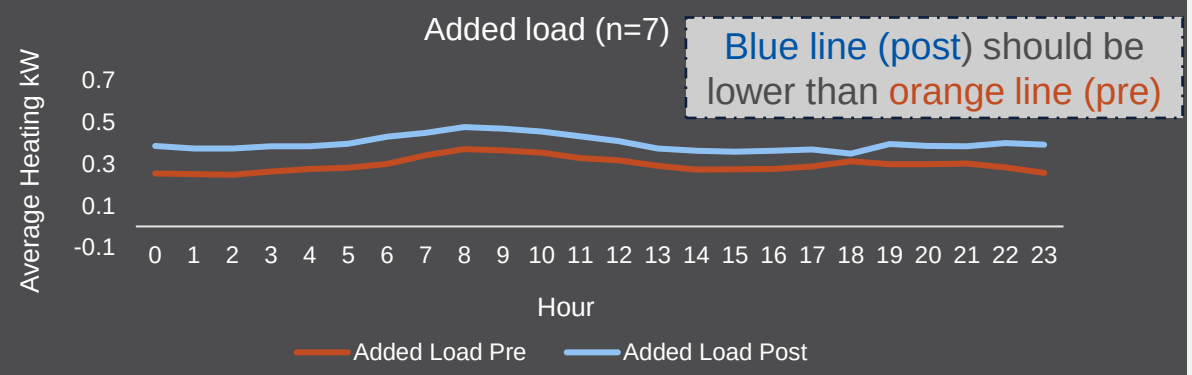
Expected changes in usage **(31% savings)**



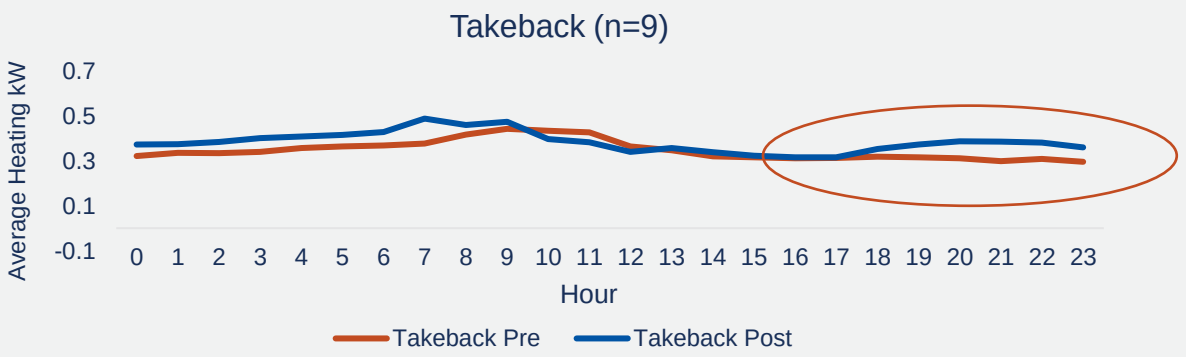
More at home usage post COVID **(19% increase)**



Added heating load **(35% increase)**



Evening takeback **(11% increase)**



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Conclusions and Recommendations on Impact

On average, participants are **saving 23%** of their annual electricity use (23% of heating and 27% of their cooling usage), **but 20% having negative outcome with increased usage & bills.**

Review appropriate customers and segments for cold-climate heat pumps initiatives.

Savings are **lower than expected and some customers seeing increase**. Explanations include tenant's continued use of baseboard heating or non-optimal use of the new CCHP systems.

Review materials left behind for tenants and clarify instructions on how to optimize CCHP usage.

Questions?

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Small Business Pilot: Impact Evaluation Highlights

Sagar Deo, TRC Companies

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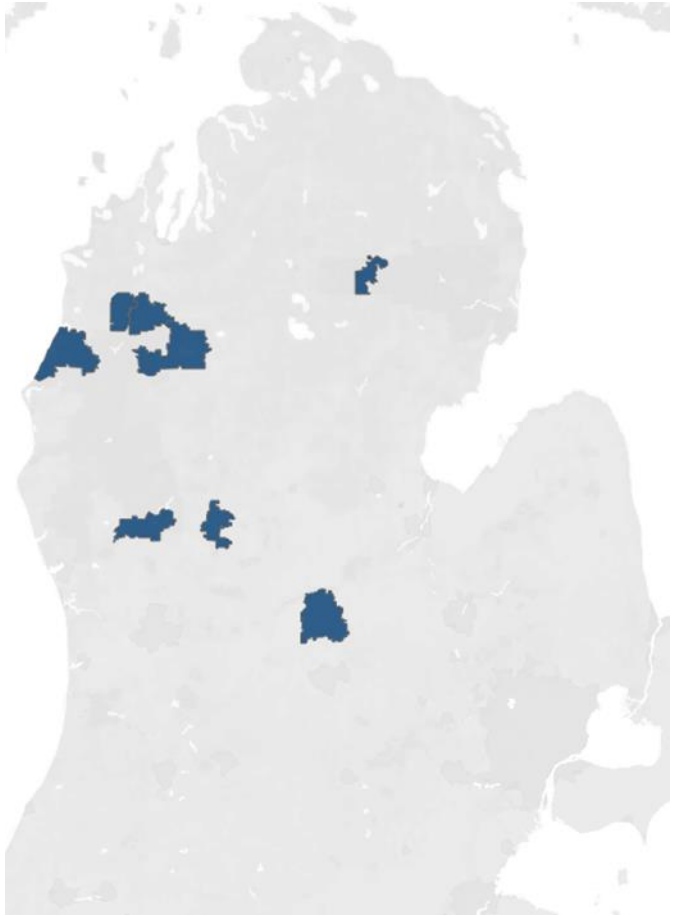
Pilot Participants

22 heat pumps were installed at **9 sites**

Site ID	Business Type	City	Installed Heat Pump Capacity (ton)	Number of Units Analyzed
1	Small Retail (Auto Sales)	Lakeview	5	2
2	Fire Station	Mesick	3	1
3	Light Industrial	Cadillac	3	1
4	Full-Service Restaurant	Copemish	8	2
5	Small Retail (Hardware Store)	Copemish	5	2
6	Municipal Building	Luzerne	3	1
7	Primary School	St John	37	7
8	Religious Building	Newaygo	10.5	5
9	Animal Shelter	Manistee	6.5	1
		Total	**81**	**22**



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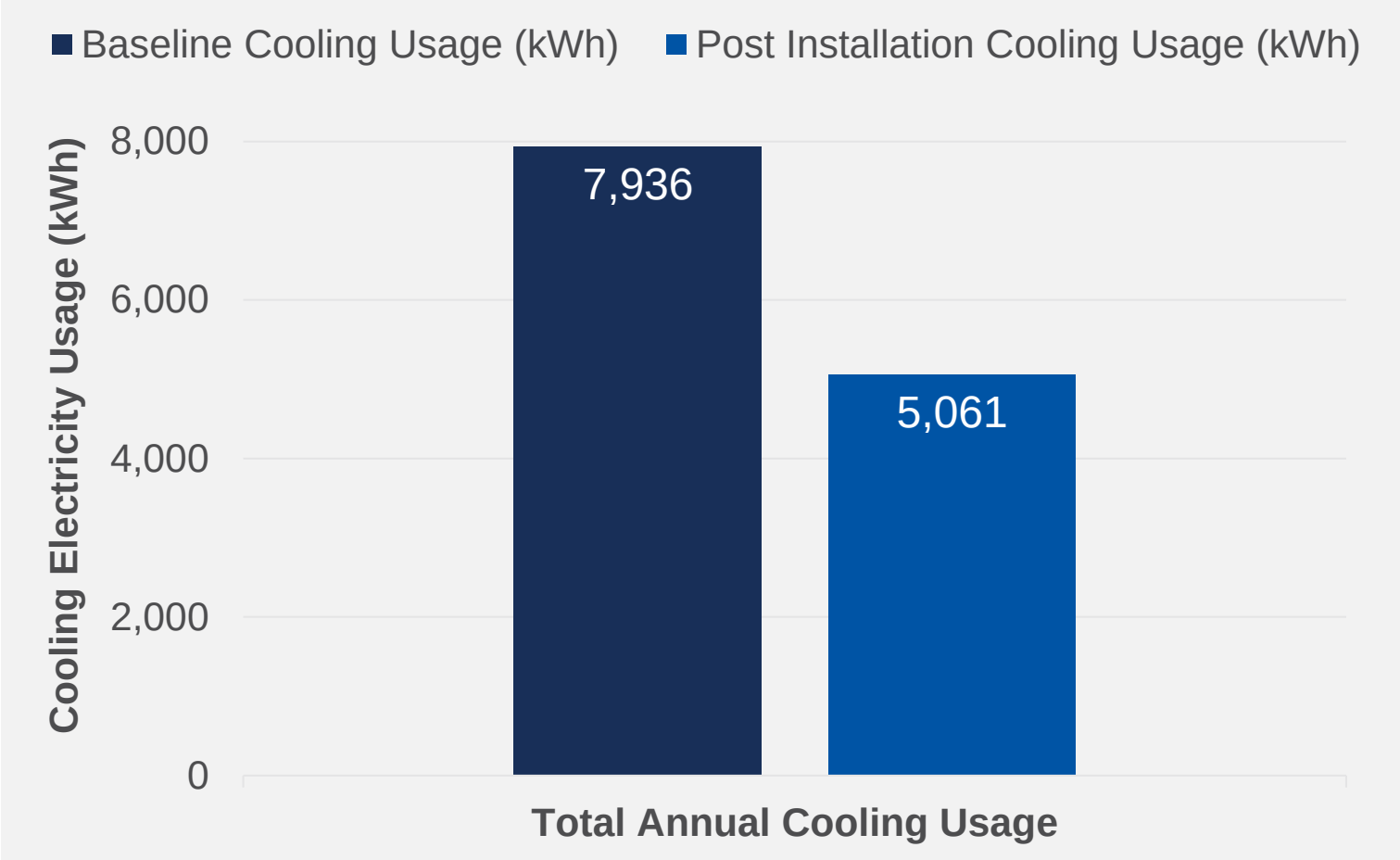
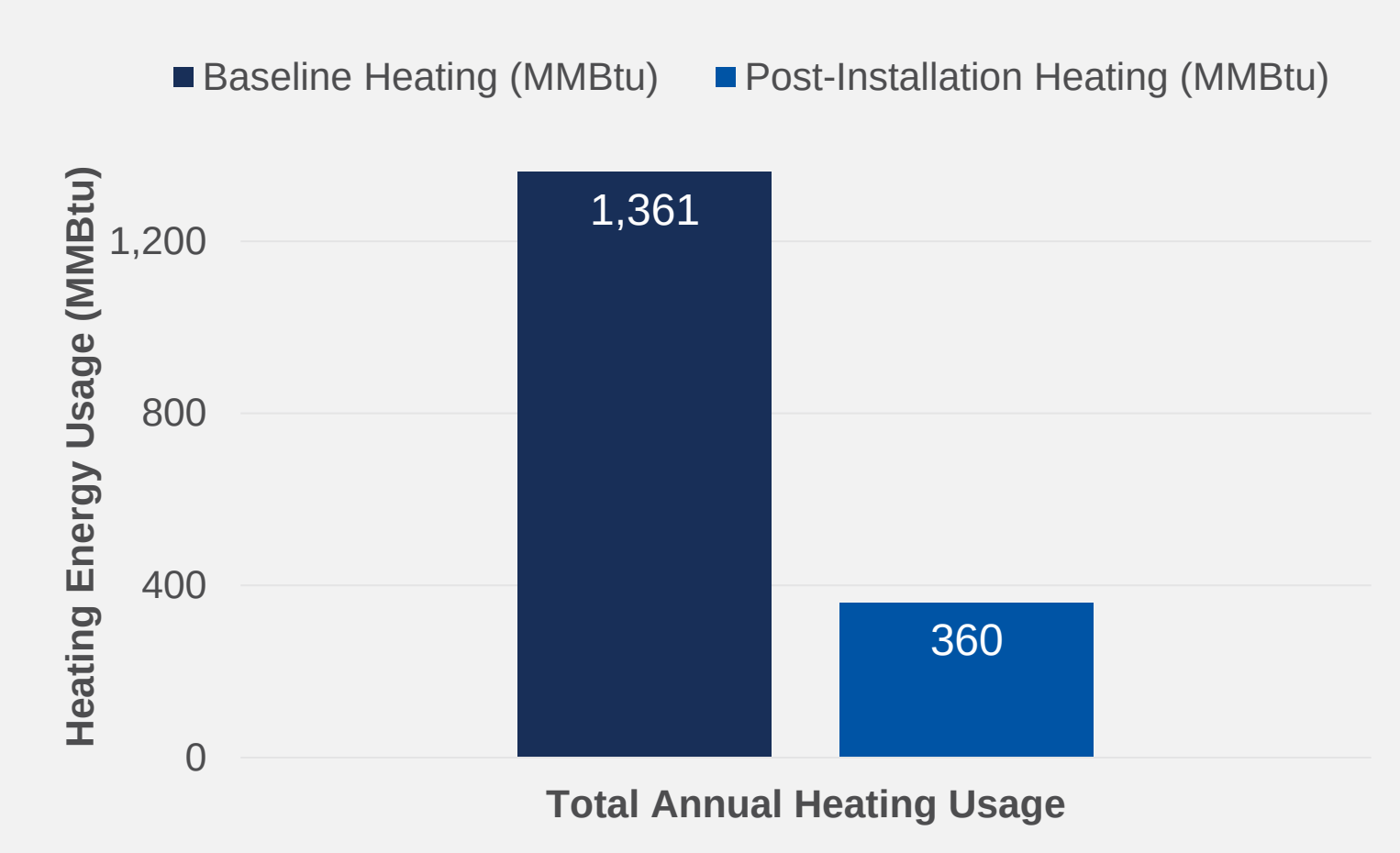
The pilot achieved a 36% reduction in cooling energy use.

Cold-climate heat pumps **reduced total cooling electricity usage** across all sites by **36% (2,875 kWh)** on average across customers who had an existing baseline cooling system.



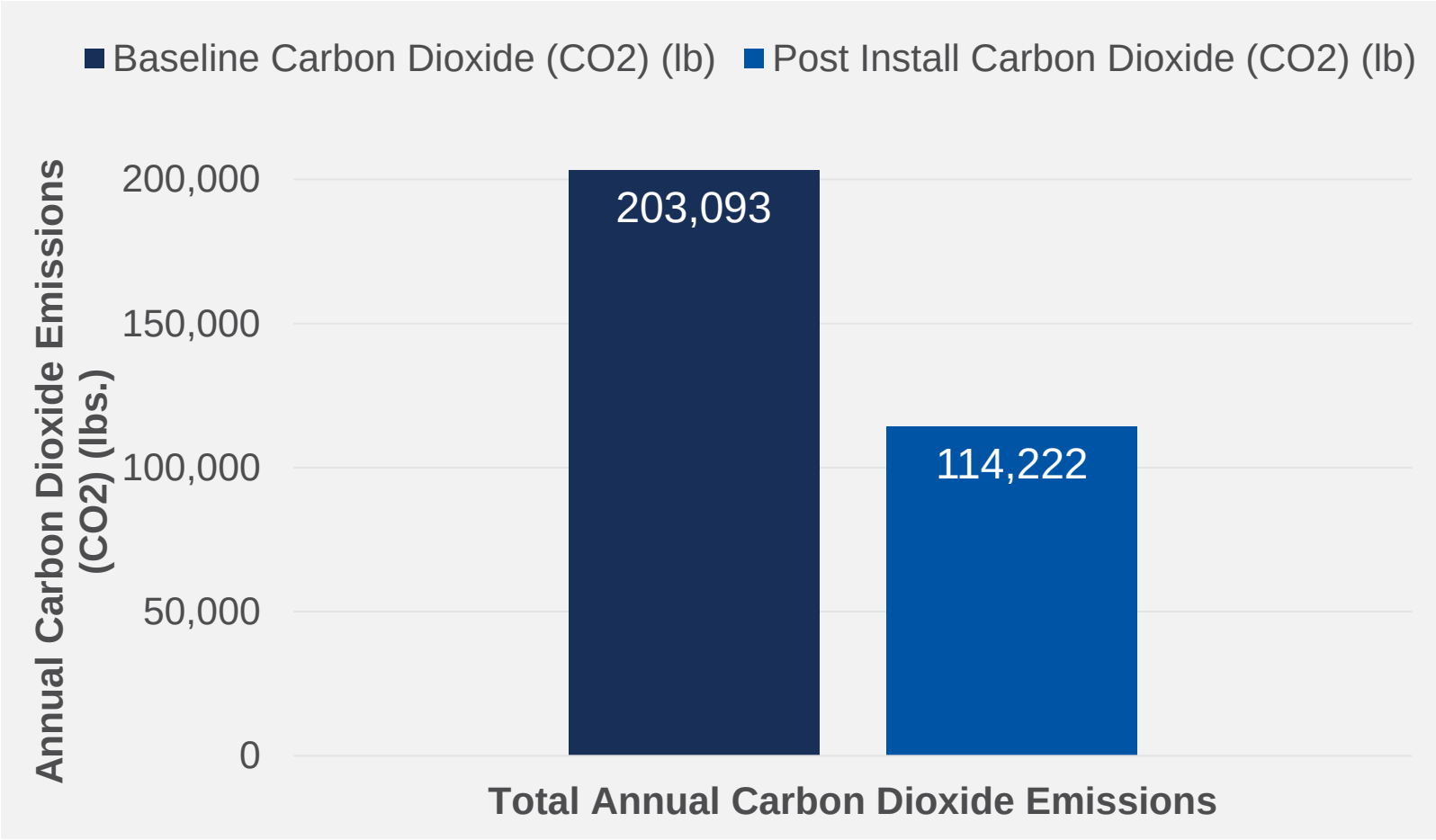
The pilot achieved a 74% reduction in heating energy use.

Cold-climate heat pumps **reduced propane** and **increased electricity** usage, resulting in a **net decrease of 74% (1,001 MMBtu)** in total heating energy consumption across all sites.



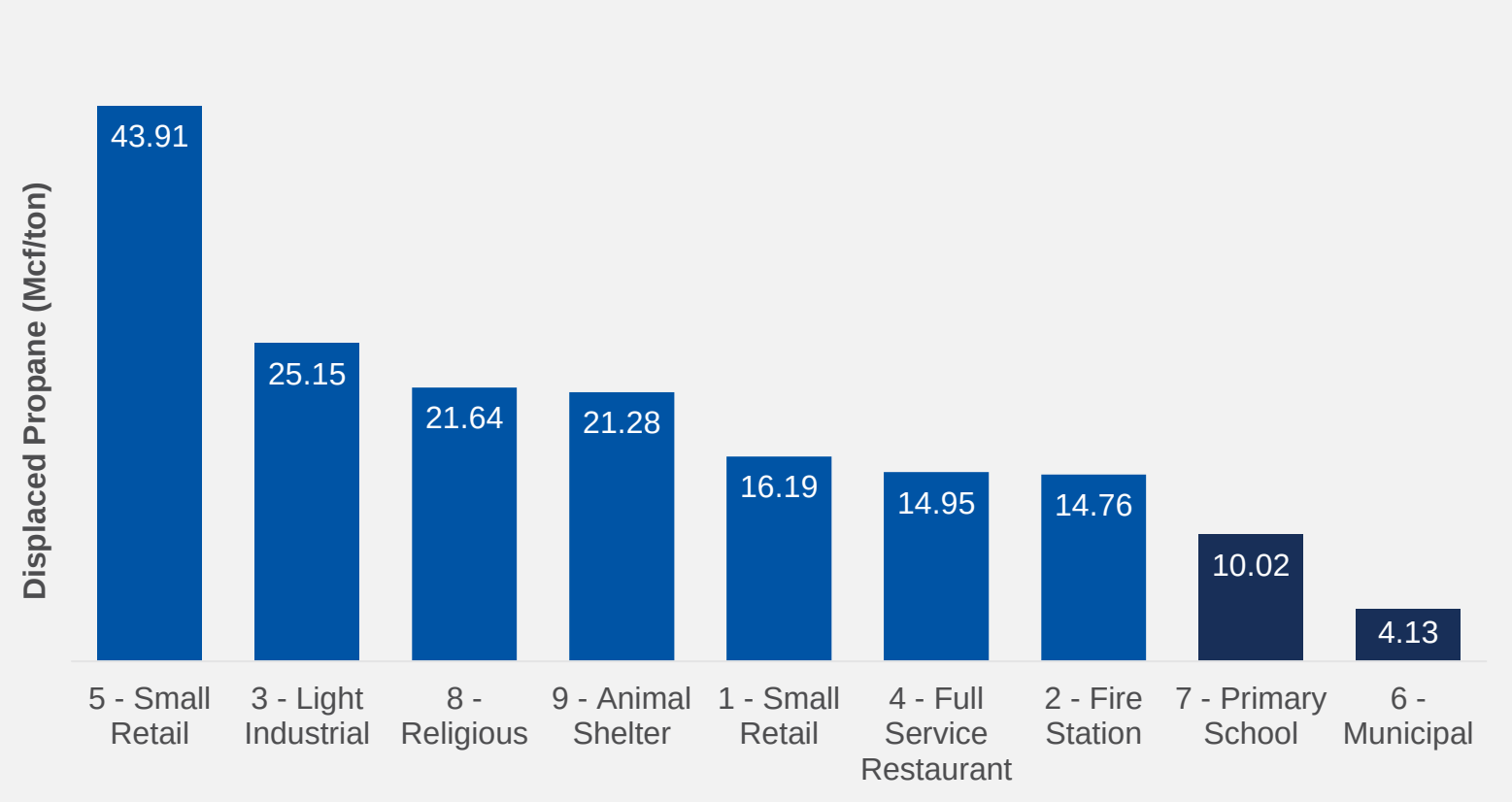
The Pilot achieved a 44% reduction in CO2 emissions.

Cold-climate heat pumps **reduced carbon dioxide emissions by 44% (88,870 lbs.)** across all sites.



Finding

Use of a heat pump can vary significantly based on configuration and occupancy



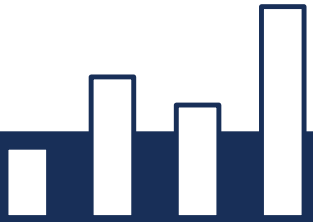
CCHP units installed at **Site 6** and **Site 7** provided **significantly less heating** than units at other locations.

- CCHP unit at **Site 6** was part of a hybrid system **configured to use mostly propane** and the building had **low occupancy**
- One CCHP unit at **Site 7 was not correctly integrated** with the building automation system

Recommendations to Improve Impact

Conduct Customer Training Sessions

- Contractors should teach customers how to use controls and settings
- Implementation team should develop reference material for customers



Install Heat Pumps In High-Use Areas

Ensure that heat pumps are installed in

- High-use locations with
- Higher hours of occupied operation

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Questions?

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Thank You!

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Income Qualified Multifamily Pilot

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Appendices

Appendix A: Income Qualified Multifamily Detailed Methodology and Sample Attrition

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Billing Analysis Methodology

STEP 1: COLLECT AMI ELECTRIC USAGE

Compile Consumers Energy AMI data for each household

STEP 2: PERFORM DISAGGREGATION

Estimate hourly disaggregation / weather-normalization models for each customer

Estimate the heating and cooling kilowatt components of usage

STEP 3: MATCH NONPARTICIPANT GROUP

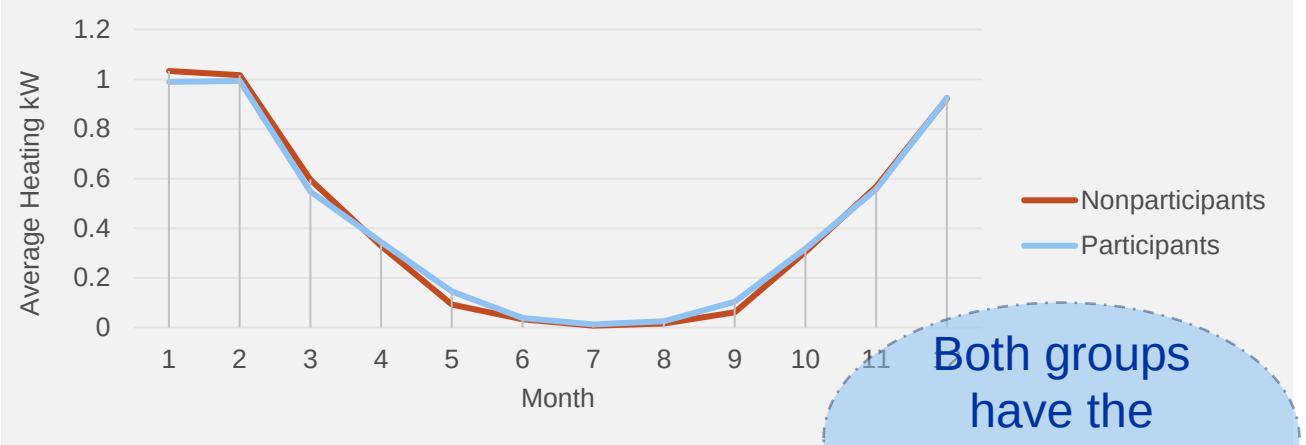
Develop a baseline comparison of nonparticipants matched to participant pre-installation usage

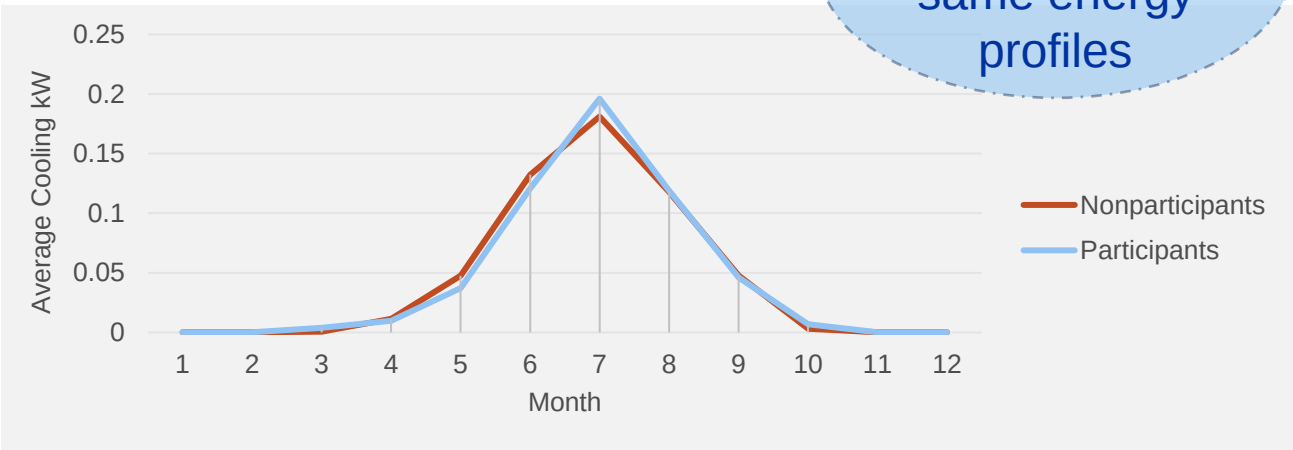
STEP 4: ASSESS CHANGE IN ENERGY USE

Determine energy savings as the difference in energy usage between participants and nonparticipants in the pre- and post-installation periods

Successful Baseline Period Matching

Pre-installation usage patterns for participants (treatment) and nonparticipants (control)





Both groups have the same energy profiles

Verified similar usage

Participants: **3,626 kWh** annual heating
234 kWh annual cooling

Nonparticipants: **3,610 kWh** annual heating
236 kWh annual cooling

Cleaned the data

Looked for new tenants, abnormal tenant usage behavior, vacancy, and non-program induced changes

Weather normalized the data

Accounted for differences in weather and climate

Sample and Attrition: Final Participant Group

Participant and nonparticipant groups showed typical attrition rates for this type of analysis

Screen	Participants	Nonparticipants
Initial Requested Sample (Unit or Household)	**97**	**2,329**
AMI Data Available	96	2,308
Determined That Dwelling Used Electric Heating	**96**	**145**
Sufficient Pre-Post Billing Data	94	145
Pre-Post Change within 70%	87	132
Remove Outliers/Vacancies	77	132
Passed Pre-Post Hourly PRISM Models/Hourly Prediction	77	119
Matching Usage to Participants	N/A	112
Final	**77**	**112**

Nonparticipant Attrition: 9% had electric heat signature (consistent with expectations)

77% of electrically heated nonparticipants were kept in the analysis

Participant Attrition: 79% of accounts were kept in the final analysis

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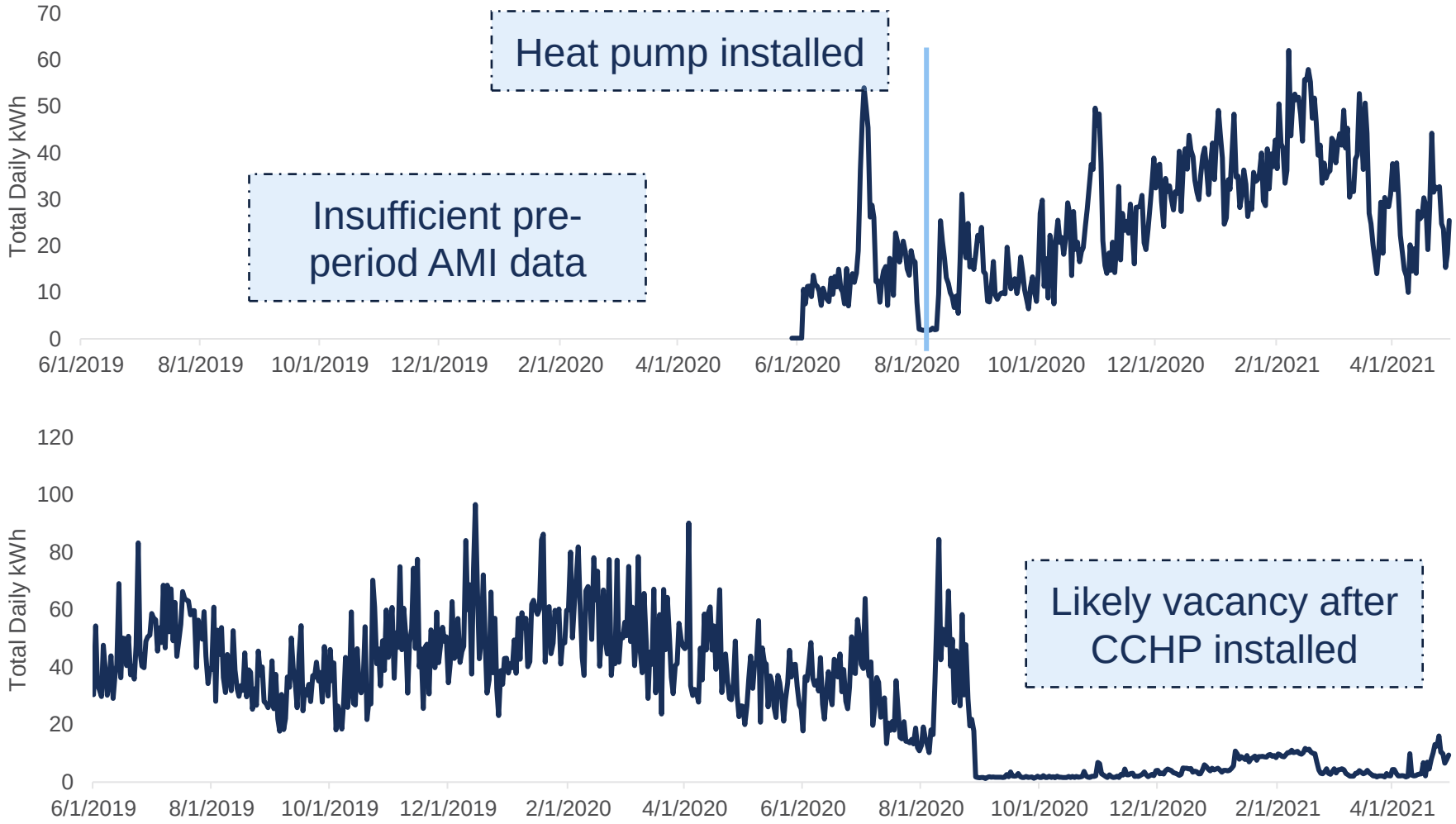
Analysis Attrition Examples

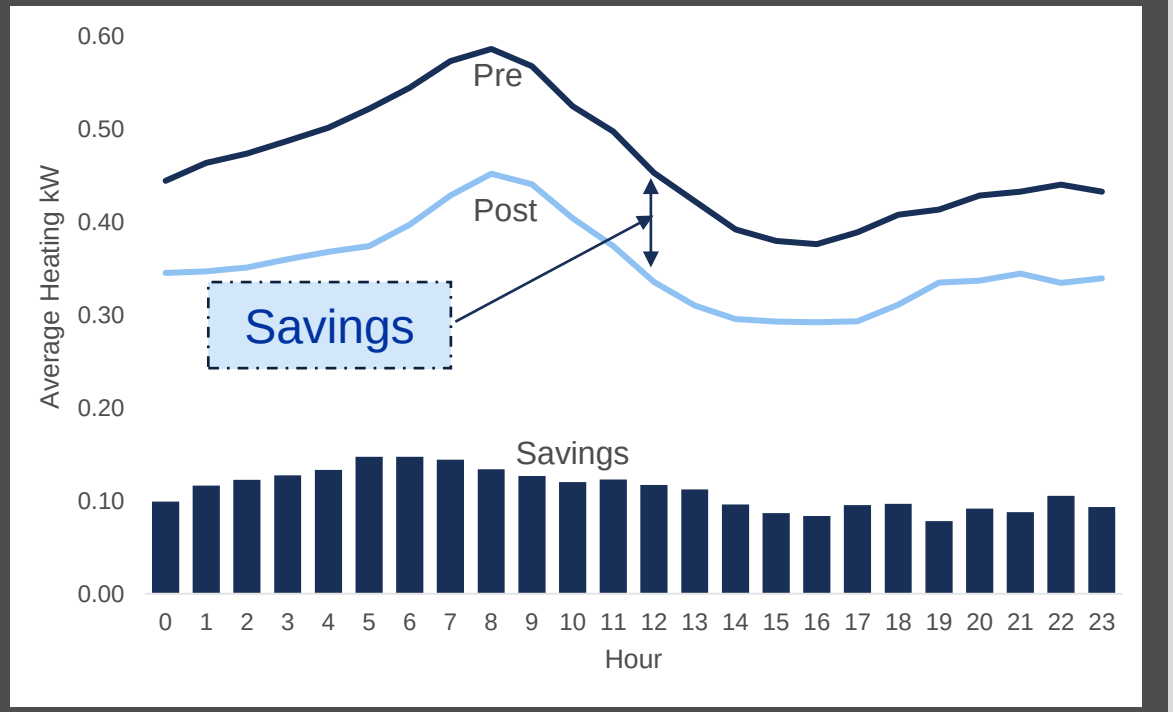
Households were removed from the analysis due to data anomalies



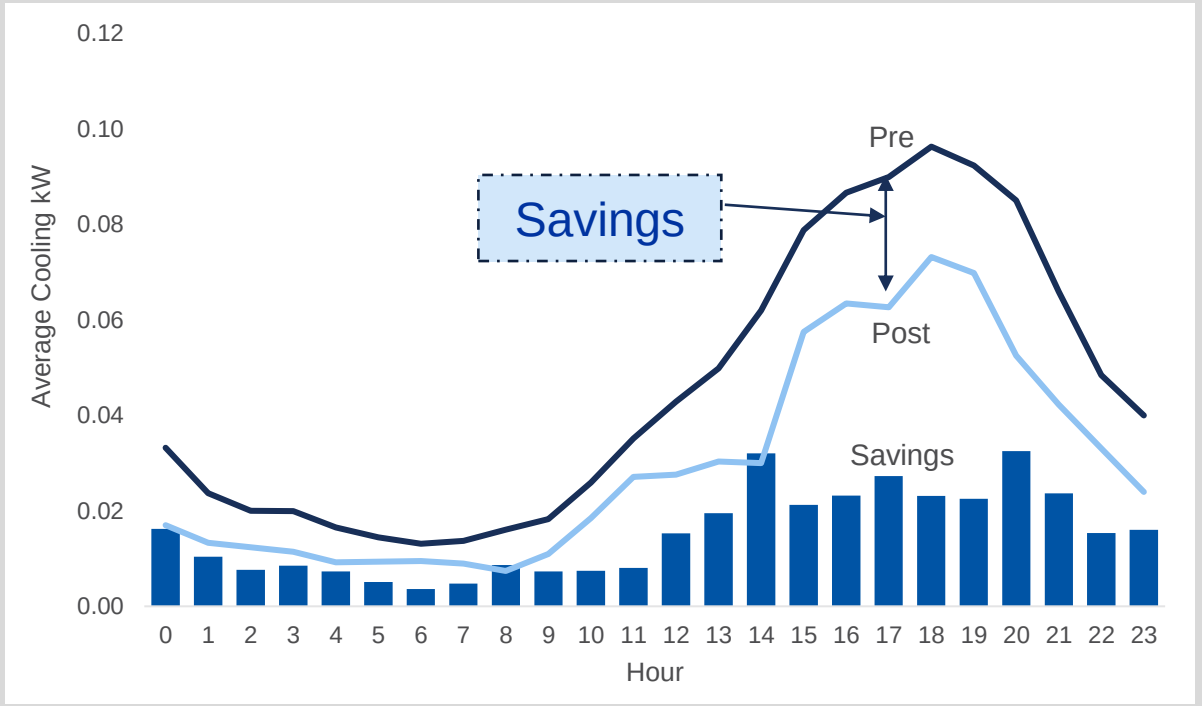
Appendix A: Income Qualified Multifamily Detailed Findings

Temperature drives hourly energy savings

WINTER HEATING: **23% SAVINGS**

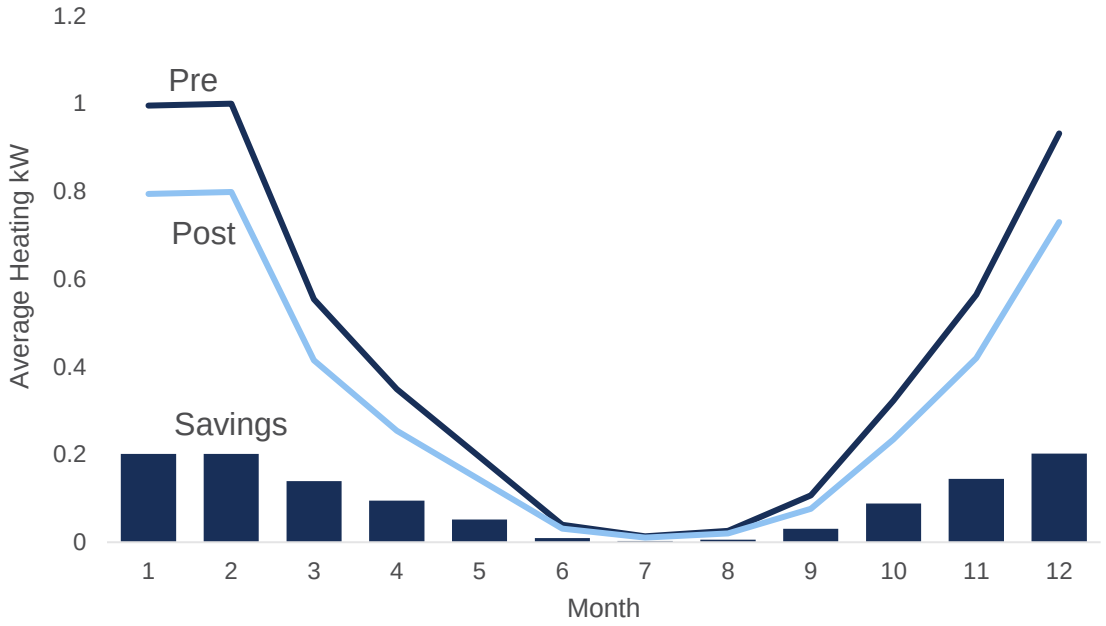


SUMMER COOLING: **27% SAVINGS**



Seasonality drives annual electric energy savings

WINTER HEATING : **23% SAVINGS**



SUMMER COOLING : **27% SAVINGS**

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Appendix B: Small Business Detailed Methodology & Findings

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Analysis Methodology

Metered data was used to estimate the annual heating (MMBtu) and cooling (kWh) energy savings.

STEP 1

Estimate weather-normalized propane and electric energy consumption for **baseline** heating and cooling systems.

STEP 2

Estimate weather-normalized heating and cooling electric energy consumption for **CCHP units**.

STEP 3

Estimate **annual heating energy savings** as the difference between baseline and CCHP unit heating consumption (in MMBtu).

STEP 4

Estimate **annual cooling energy savings** as the difference between baseline and CCHP unit cooling consumption.

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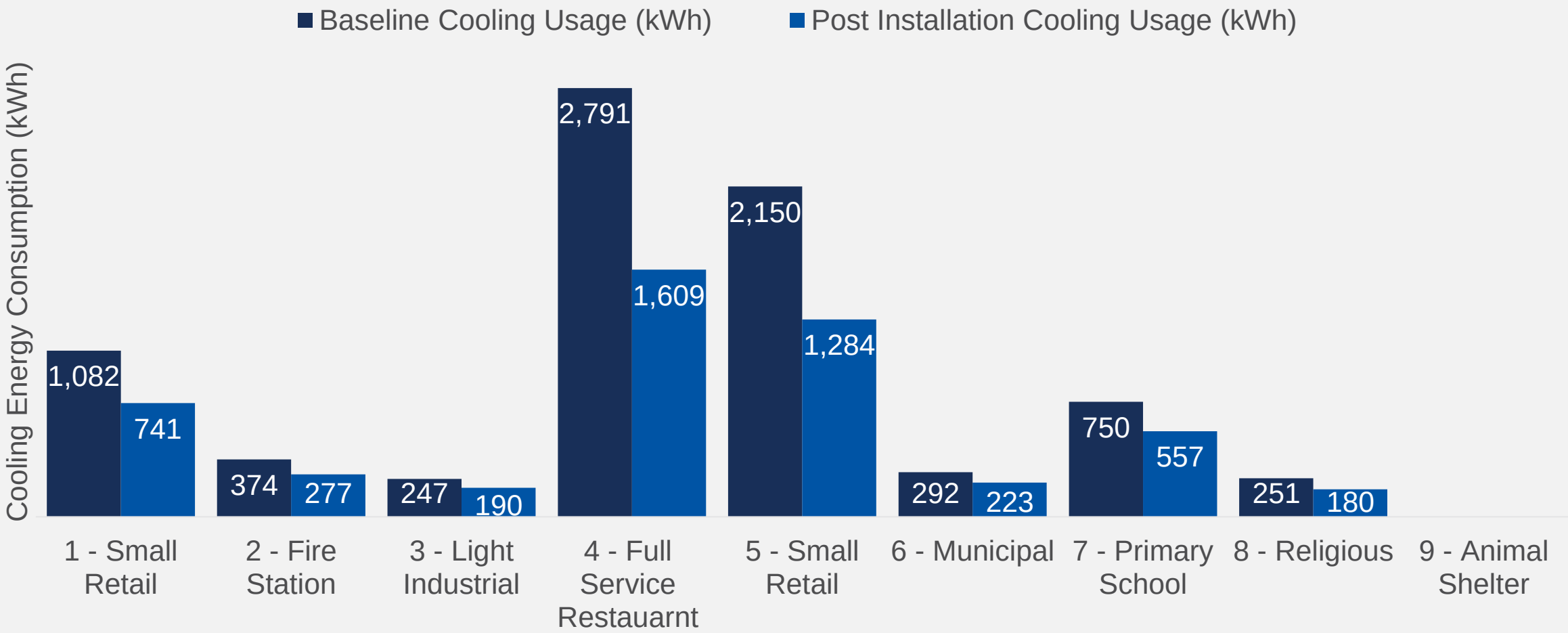
Impact on Energy Usage: Cooling

Baseline and Post-Installation Cooling Usage by Site



Impact on Energy Usage: Heating

Baseline and Post Installation Heating Usage by Site